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DOI: https://doi.org/10.1097/RLU.0000000000001053

Visualization of Parathyroid Hyperplasia Using ^{18}F-Fluorocholine PET/MR in a Patient With Secondary Hyperparathyroidism

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Abstract: Several imaging modalities exist for the detection of parathyroid adenomas in patients with primary hyperparathyroidism. Unlike solitary parathyroid adenoma, parathyroid hyperplasia in patients with secondary hyperparathyroidism hitherto is difficult to assess with any imaging modality. Our case of a young patient with chronic kidney failure illustrates that ^{18}F-fluorocholine PET/MR might be an imaging tool suitable for the diagnosis and presurgical assessment of parathyroid hyperplasia.

Key Words: ^{18}F-choline, hyperparathyroidism, parathyroid hormone, PET/MR

(*Clin Nucl Med* 2015;00: 00–00)

Received for publication June 19, 2015; revision accepted September 11, 2015.
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Conflicts of interest and sources of funding: none declared.
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ISSN: 0363-9762/15/0000–0000
DOI: 10.1097/RLU.0000000000001053

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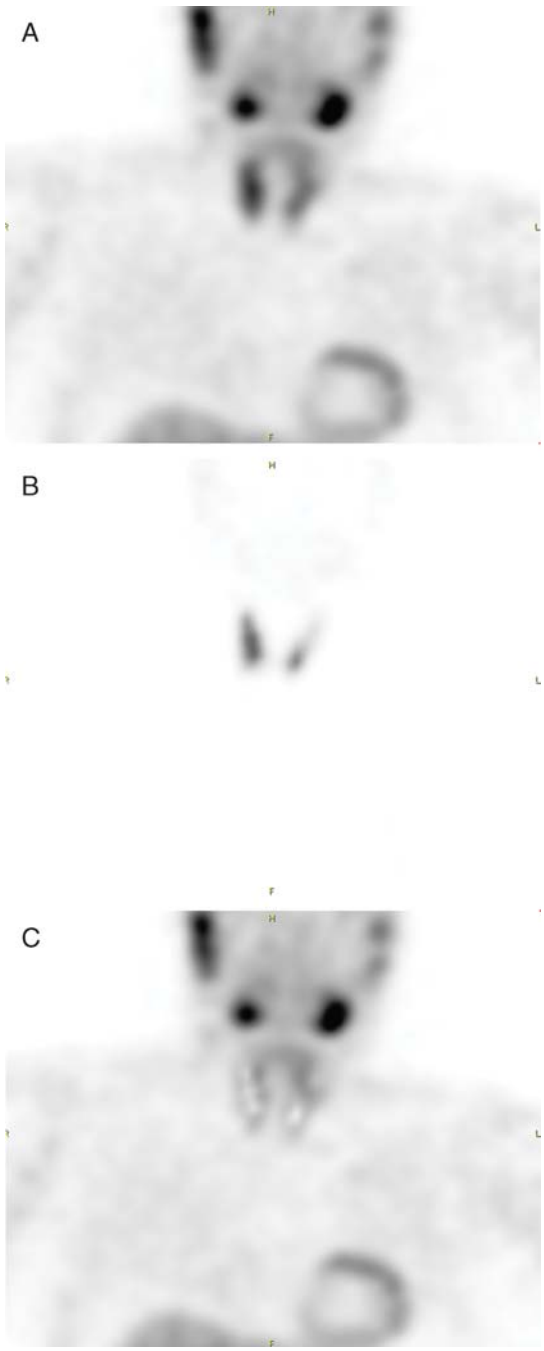

FIGURE 1. Conventional dual-isotope scintigraphy of the neck in a 35-year-old man with chronic kidney failure and clinical suspicion of autonomous parathyroid hormone (PTH) secretion. During the last 7 months, the patient's serum PTH concentration was increasing from 830 to 1130 ng/L (reference range, 15–65 ng/L), whereas the serum calcium concentration was normal. Coronal ^{99m}Tc-tetrofosmin image (**A**), ^{123}I image (**B**), and subtraction image (**C**) reveal no suspicious lesion in the neck or upper mediastinum. Ultrasonography (not shown) was negative as well.

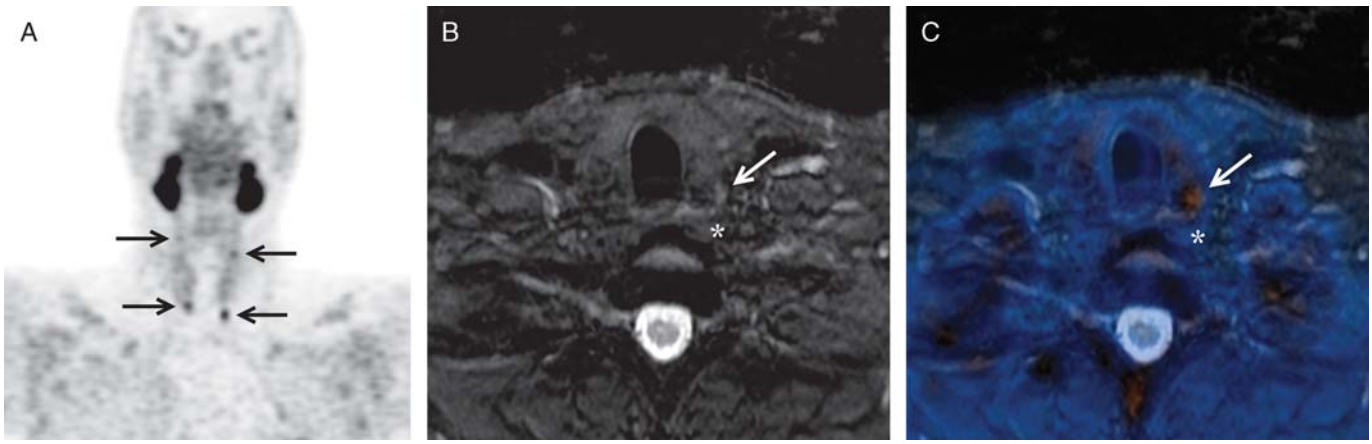

FIGURE 2. ^{18}F-fluorocholine PET/MR imaging of the neck acquired 3 weeks later. Coronal ^{18}F-fluorocholine PET image (**A**) shows 4 small active lesions (arrows), situated bilaterally at the upper and lower end of the thyroid gland. Inferior lesions are most prominent. Axial T2-weighted fat-suppressed MR image (**B**) and ^{18}F-fluorocholine PET/MR image (**C**) at the level of the left-sided inferior lesion reveal a small hyperintense nodule (arrow) between thyroid gland and longus colli muscle (asterisk). Along with the patient's clinical history, these imaging findings are consistent with parathyroid hyperplasia. Secondary hyperparathyroidism occurs in patients with chronic kidney failure or other causes of vitamin D deficiency such as malabsorption. The lack of bioactive calcitriol (1,25-dihydroxyvitamin D_3) causes hypocalcemia, which is corrected by an appropriate increase in PTH synthesis. Tertiary hyperparathyroidism develops if this endocrine relationship is uncoupled and PTH secretions increase despite normal or even elevated serum calcium. In both conditions, parathyroid hyperplasia represents the typical histopathologic correlate. Surgical therapy can be curative, and usually all parathyroid glands but the smallest one are resected. The current imaging standard in patients with hyperparathyroidism is dual-tracer subtraction scintigraphy using ^{99m}Tc-tetrofosmin and ^{123}I, together with ultrasonography.[1,2] The sensitivity and specificity of these methods are high (approximately 90%) in patients with single parathyroid adenomas, but lower (30%–80%) if multiple gland pathology is present.[3–6] Negative imaging findings in patients with hyperparathyroidism are a problem.[7] Recently, dynamic contrast-enhanced CT imaging and choline PET/CT imaging have been advocated to identify parathyroid adenomas if conventional imaging was negative.[8–13] Normally functioning parathyroid glands are not seen on choline PET images, but occasionally incidental parathyroid adenomas are found in patients undergoing prostate cancer staging with choline PET, and hitherto unnoticed primary hyperparathyroidism is revealed.[11,14,15] Secondary hyperparathyroidism and tertiary hyperparathyroidism most often result in asymmetrical parathyroid gland hyperplasia and only subtle glandular enlargement, as seen in our case.[1,16,17] The inferior parathyroid glands usually are more hyperplastic than the superior parathyroid glands. ^{18}F-fluorocholine PET/CT has been suggested as first-line imaging modality for the detection of hyperfunctioning parathyroid glands in patients with secondary hyperparathyroidism.[11,18] We believe that ^{18}F-fluorocholine PET/MR might be even more suitable, owing to less radiation exposure and higher soft-tissue contrast of MR, allowing for a morphological correlation of PET findings. ^{18}F-fluorocholine PET/MR might also aid surgical planning, confirming not only the presence of parathyroid hyperplasia, but also mapping the location and size of hyperplastic parathyroid glands.